

CLAIMS

What is claimed is:

1. A network having a plurality of multicast connections, said network comprising:
an input stage comprising r_1 input switches, and n_1 inlet links for each of said r_1
5 input switches;
an output stage comprising r_2 output switches, and n_2 outlet links for each of
said r_2 output switches; and
a middle stage comprising m middle switches, and each middle switch
comprising at least one link (hereinafter "first internal link") connected to each input
10 switch for a total of at least r_1 first internal links, each middle switch further comprising
at least one link (hereinafter "second internal link") connected to each output switch for a
total of at least r_2 second internal links;
wherein each multicast connection from an inlet link passes through at most two
middle switches, and said multicast connection further passes to a plurality of outlet links
15 from said at most two middle switches.
2. The network of claim 1, wherein $m \geq 2 * n_1 + n_2 - 1$.
3. The network of claim 2,
further is always capable of setting up said multicast connection by never
changing path of an existing multicast connection, and the network is hereinafter "strictly
20 nonblocking network".
4. The network of claim 1 further comprising a controller coupled to each of said
input, output and middle stages to set up said multicast connection.
5. The network of claim 2 wherein said r_1 input switches and r_2 output switches are
the same number of switches.

6. The network of claim 2 wherein said n_1 inlet links and n_2 outlet links are the same number of links and $n_1 = n_2 = n$, then $m \geq 3 * n - 1$.
7. The strictly nonblocking network of claim 3,
wherein each of said input switches, or each of said output switches, or each of
5 said middle switches further recursively comprise one or more strictly nonblocking
networks.
8. The network of claim 1,
wherein each of said input switches, or each of said output switches, or each of
said middle switches further recursively comprise one or more networks.
- 10 9. A method for setting up one or more multicast connections in a network having an
input stage having $n_1 * r_1$ inlet links and r_1 input switches, an output stage having $n_2 * r_2$
outlet links and r_2 output switches, and a middle stage having m middle switches,
where each middle switch is connected to each of said r_1 input switches through r_1 first
internal links and each middle switch further comprising at least one link connected to at
15 most d said output switches for a total of at least d second internal links, wherein
 $1 \leq d \leq r_2$, said method comprising:
 - receiving a multicast connection at said input stage;
 - fanning out said multicast connection in said input stage into at most two middle
switches to set up said multicast connection to a plurality of output switches among said
20 r_2 output switches, wherein said plurality of output switches are specified as destinations
of said multicast connection, wherein first internal links from said input switch to said at
most two middle switches and second internal links to said destinations from said at most
two middle switches are available.
10. A method of claim 9 wherein said act of fanning out is performed without
25 changing any existing connection to pass through another middle switch.
11. A method of claim 9 wherein said act of fanning out is performed recursively.

12. A method for setting up one or more multicast connections in a network having an input stage having $n_1 * r_1$ inlet links and r_1 input switches, an output stage having $n_2 * r_2$ outlet links and r_2 output switches, and a middle stage having m middle switches, where each middle switch is connected to each of said r_1 input switches through r_1 first internal links and each middle switch further comprising at least one link connected to at most d said output switches for a total of at least d second internal links, wherein $1 \leq d \leq r_2$, said method comprising:

checking if at least a first subset of destination output switches of said multicast connection have available second internal links to a first middle switch; and

10 checking if a second middle switch has available second internal links to a second subset of destination output switches of said multicast connection.

wherein each destination output switch of said multicast connection is one of said first subset of destination output switches and said second subset of destination output switches.

15 13. The method of claim 12 further comprising:
 checking if the input switch of said multicast connection has an available first internal link to said first middle switch and to said second middle switch.

14. The method of claim 12 further comprising:
 prior to said checkings, checking if all the destination output switches of said 20 multicast connection are available at said first middle switch.

15. The method of claim 12 further comprising:
 repeating said checkings of available second internal links to another second subset of destination output switches for each middle switch other than said first and said second middle switches.

25 wherein each destination output switch of said multicast connection is one of said first subset of destination output switches and said second subset of destination output switches.

16. The method of claim 12 further comprising: